

Protocol

2F1: HFC EMISSIONS FROM AUTOMOTIVE COMFORT COOLING

IPCC Category:	2F1
NFR Code:	n.a.
NOSE Code:	n.a.
NACE Code 2008	29, 45, 309102 and 4730

FOREWORD

Under the Kyoto Protocol, the Netherlands is required to set up and maintain a national system to monitor its greenhouse gas emissions. One of the elements of this system is a transparent and verifiable description of the methods and processes used in this monitoring system. These methods must meet international guideline criteria, which have been defined by the United Nations (UN) and the European Union (EU).

The Netherlands meets the aforementioned requirement, for example, by defining a series of Monitoring Protocols, which describe the methods and work processes used to determine greenhouse gas emissions and the amounts of carbon sinks available. Protocols have been written for about 40 greenhouse gas sources or sinks. This document describes the protocol for one of these sources or sinks.

The protocols have been compiled in close collaboration with experts from various sectors of society in the Netherlands, particularly experts from the Emissions Registration (ER). The ER is a collaborative group that includes institutions such as CBS, WUR, RIVM and PBL. Until 31 December 2009 this was coordinated by PBL (Planbureau for the Leefomgeving, or the Netherlands Environmental Assessment Agency), but on 1 January 2010 this coordination task was taken over by RIVM (the Netherlands institute for public health and the environment). Other institutions that have contributed to the protocols include NL Agency; Ministry of Agriculture, Nature and Food Quality; and the Ministry of VROM (Housing, Spatial Planning and the Environment).

1 SCOPE AND SIGNIFICANCE OF EMISSION SOURCES/ACTIVITIES

1.1 Scope and definition

This protocol describes the estimates of HFC (hydrofluorocarbon) emissions from automotive comfort cooling (IPCC code 2F1). For the situation in the Netherlands, this includes only air-conditioning units up to 3 kg in cars, small vans and the cabins of lorries, tractors and various other vehicles/equipment. Conform the IPCC guidelines, the cooling of cargo holds in lorries and the air conditioning in buses, trains and coaches are reported under the stationary cooling (transport cooling) sector, due to the size of the equipment and the techniques used.

This protocol applies to the companies in categories 29,45, 309102 and 4730 of the 1995 Chamber of Commerce company index (BIK95): Production of cars and trailers and Trade and repair of cars and motorbikes.

In the past, air-conditioning units containing R12 were sold throughout the industry, and a number of these cars are still on the road today. However, since 1995 all air-conditioning units for private cars are filled at the factory with R134a coolant. According to the figures from the RAI Association, 289 tons of pre-filled R134a were supplied in 1999, of which 271 tons were used in cars, 9 tons in delivery vans and 9 tons in cabin air conditioners for lorries (De Baedts et al., 2001).

1.2 Significance and influences

1.2.1 Contribution to total national emissions

The HFC emissions from automotive comfort cooling contribute less than 0.1% to the total annual Netherlands greenhouse gas emissions.

1.2.2 Developments that influence emissions

Car emissions have been drastically reduced over the past few years due to better sealing, and thus fewer leaks. However, the number of cars with air conditioning has also increased considerably, resulting in the rise in total emissions from 1995 onwards.

2 METHOD, EMISSION FACTORS AND ACTIVITY DATA

2.1 Calculation method

HFC134a emissions during the initial filling, usage and demolition phases are calculated using the following formula:

Annual emissions =

+ *(Total initial R134a filling in year t) * VV*
+ *(Total R134a stock (capacity) in car airco units in year t) * L*
+ *(Original capacity – destroyed R134a) from scrapped cars with air conditioning*

Where: * VV represents the loss (emissions) during the initial filling (assumed to be 0.5%)
* L represents the annual leakage percentage of the total stock of air-conditioned cars (this percentage depends on the type and age of the vehicles).

The numbers of cars (with air conditioning) that have been scrapped and the amount of R134a that has been destroyed can all be obtained from the Annual Environmental Reports (AERs/MJVs) submitted by ARN (a waste processing company).

The method used conforms to the IPCC 'bottom-up' method as described in the IPCC Good Practice Guidance (GPG, 2001, pp. 3.107-3.114). Both country-specific and default emission factors (tier 2) are used.

2.2 Emission factors

The emission losses during the initial filling (VV) are assumed to be 0.5% (= default value stated in the IPCC's GPG, 2001). Up until the year 2000 the leakage percentages (L) for airco usage were taken from the literature (Matthijssen and Kroeze, 1996). From 2000 onwards these percentages are taken from the NOKS study. For cars this is an average of 9% (equipment from 1999 onwards) and 13% (equipment installed before the end of 1998), with delivery vans and lorry cabins also leaking 13% (all years).

2.3 Activity data

Handelsstroomonderzoek/Trade flow study

This study, which is conducted annually, provides an overview of the amounts of HFCs being traded. These amounts include the initial filling of the airco unit, plus any subsequent amounts

added later. The usage figures for coolant and air conditioners were first split into various applications, including ‘mobile air conditioning’, during the 2001 inventory (also for previous years). However, the usage figures for the years 1995-2000 were determined via the emissions calculations, and assume that the emissions (total stock of coolant in aircos * leakage percentage) are equal to the usage.

NOKS

This is a single study that was implemented by NOKS (national research into coolant flows) for the year 1999 (De Baedts et al., 2001), which covered both stationary cooling and mobile air conditioning. The import figure for new cars is a known fact. The penetration rate for air conditioning is determined for three categories: cars, small delivery vans and cabin air conditioners for lorries. The number of cars containing air conditioning is determined, as well as the average capacity thereof.

Number of cars with air conditioning

Up to the end of 2002 the RAI Association determined the number of cars with air conditioning. Thereafter, this figure is estimated based on the total number of cars sold, and an expert evaluation of the airco penetration rate. The following information is also required:

- Number of cars, delivery vans and lorries (per manufacturing year) with/without air conditioning that have been exported (via Statline, CBS).
- Annual number of scrapped cars with airco (R134a), up to 3500 kg GVW (gross vehicle weight), plus the total R134a removed from these cars and its destination (via ARN, a waste processing organisation). On 1 July 2004 ARN started recycling coolants from air conditioning units in scrapped cars (ARN’s annual environmental report for 2004).

3 WORKING PROCESSES

Process for estimating (t-1)

If preliminary figures are required at any point, the following process is used to estimate the figure for t-1. The preliminary data for the work package leader are calculated by extrapolating them from the previous years’ figures, based on prognoses for the developments in the most important activity data (taken from CBS (Statistics Netherlands) or other statistical sources).

INPUT	PROCESS	OUTPUT	BY WHOM
Preliminary data work package leader (t-1)	Include t-1 data in ER database	ER-db with (t-1) data	Work package leader
ER-db with (t-1) data	Check emission figures: compare with previous years (trend), modify if required and document everything	ER-db (t-1) with any modified figures	Task force

Process for final determination of (t-2)

The final emission figures (as described in this protocol) are calculated using the following process.

INPUT	PROCESS	OUTPUT	BY WHOM
<ul style="list-style-type: none"> - Annual HFC usage figures for automotive comfort cooling for initial filling of airco units (source: Handelsstroomonderzoek/Trade flow study; confidential, thus not in annual report). - Annual total sales figures for cars, including those with airco (BOVAG/RAI) - Annual total export of existing cars (per year of manufacture) and the percentage of these with airco (Statline CBS/Statistics Netherlands). - Number of scrapped cars with airco, including the original capacity, minus amount of R134a destroyed from scrapped airco units (ARN). 	<p>Check figures for usage, sales, export and scrapped vehicles:</p> <ul style="list-style-type: none"> - Compare with previous years - Look at the trend <p>If unsubstantiated deviations found, contact the organisation supplying these figures → modify figures as necessary and document fully</p>	<p>Approved usage, sales, and export figures plus scrapped-vehicle figures</p>	<p>Work package leader</p>
<ul style="list-style-type: none"> - Approved usage, sales, and export figures plus scrapped-vehicle figures - Most recent Emission Factors (EFs), leakage percentages etc. from research/literature (both national and international) 	<p>Enter into (EXCEL) model 'Calculating F-gas emissions'</p>	<p>Detailed and aggregated emissions</p> <p>(=Final data Work package leader (t-2)).</p>	<p>Work package leader</p>
<p>Final data Work package leader (t-2)</p>	<p>Include (t-2) data in ER database</p>	<p>ER-db with (t-2) data</p>	<p>Work package leader</p>
<p>ER-db with (t-2) data</p>	<p>Check, and trend analysis of air emissions: explain deviations or modify figures</p>	<p>Final defined emission figures (t-2)</p>	<p>Task forces and PBL experts</p>

The input data for the year t-1 are supplied annually (before 1 September) to the ER's ENINA task force, which then enters this information into a spreadsheet model. Information concerning 'refilling of existing cars' from the trade flow study is used to verify the calculated emissions during usage of the air conditioning. Once this has been checked and approved, these data are filed within the ER. With the exception of the total emissions figure, all other information is treated as confidential.

4 UNCERTAINTY AND QUALITY

4.1 Estimating uncertainties

A Tier-1 uncertainty analysis is implemented every year before the NIR is submitted by the ER, based on the greenhouse gas inventory and in compliance with IPCC guidelines. The assumptions used and the results thereof are described in a background report to the NIR. In addition to this, where included in the QA/QC programme for the relevant period, extra analyses are implemented regularly in specific situations, which include any updating of the Tier-2 uncertainty analyses.

The Tier-2 uncertainty assessment was last updated in 2006. This assessment showed that a Tier-1 uncertainty assessment is sufficiently reliable and that Tier-2 uncertainty assessments need only be implemented at periodic intervals of around 5 years, unless a major change in an important source is sufficient to require earlier reassessment.

- Source-specific uncertainty

The uncertainty estimate-totaal concerns the root of the sum of uncertainty in the data sources used (AD_{onz}) in the square and the uncertainty of the emission factor (EF_{onz}) in the square. The extent of the total uncertainty is here primarily determined by the greatest AD or EF uncertainty.

$$\text{Uncertainty estimate}_{\text{total}} = \sqrt{EF_{onz.}^2 + AD_{onz.}^2}$$

The uncertainty estimates concerning the data sources (AD) and emission factors (EF) used, and the total uncertainty estimate, are listed in the following table.

IPCC	Category	Gas	AD _{onz.}	EF _{onz.}	Uncertainty estimates _{tot}
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	10	50	51

The uncertainty in HFC emissions from HFC consumption was estimated to be 51%. The uncertainty in the activity data for the HFC sources was estimated at 10%. For the emission factor, the uncertainty was estimated at 50%. All of these figures were based on expert judgements [Olivier et al, 2009].

4.2 Quality assurance and quality control (QA/QC)

The ER work package leaders check that:

1. the basic data are well documented and adopted (check for typing errors, use of the correct unit sizes and correct conversion);
2. the calculations have been implemented correctly;
3. assumptions are consistent, also whether specific parameters (e.g. activity data) are used consistently;
4. complete and consistent data sets have been supplied.

Any actions that result from these checks are noted on an ‘action list’. Before defining the data, supervisors check whether the relevant actions on this list, plus the QC checks, have all been completed. Defining the data is carried out by the WEM (working group on emissions monitoring), and confirmed in writing via an e-mail from the institute representatives to the ER project leader at PBL.

The work package leaders fill out a new documentation sheet when adding new data. For reasons of efficiency a minimum level has been set for obligatory documentation, i.e. 5% changes at target group level, and 0.5% at levels concerning the national total. These documentation sheets form part of the trend analysis, as well as the eventual definition of the data set.

The ER work package leaders communicate by e-mail regarding these QC checks, results and actions. They send a printed copy to the ER secretary, who keeps a logbook and compiles these e-mails into an ‘action list’. This shows explicitly that the required checks and corrections have been carried out.

4.3 Verification

In order to check the quality of the emission figures for the sources in this protocol, general QA/QC procedures have been followed that are in line with the IPCC guidelines. These are described further in the QAQC programme used by the National System, and the annual working plans published by the ER.

- Sector-specific QC

No additional specific verification procedures are implemented for the sources defined in this protocol.

4.4 Possibilities for improvement compared to the current calculation method

4.4.1 History

The method described in Section 2.1 has been used from the very beginning: only the leakage percentage has been changed (see Section 2.2).

4.4.2 Future

The European Parliament and Council published Guideline 2006/40/EC in 2006. This guideline includes the fact, among others, that from 1 January 2011 EU Member States may no longer approve vehicle types that include a climate control system designed to use fluor-based greenhouse gases with a GWP (global warming potential) in excess of 150.

5 REMAINING ASPECTS

5.1 Point source criteria

Not applicable

5.2 Substance profiles

Not applicable

5.3 Regionalisation

Not applicable

5.4 Time-based variations in source strength

Not applicable

6 REFERENCES AND ADDITIONAL INFORMATION

6.1 References

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6.2 Additional information

Not applicable